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Retirement Board
California State Teachers' Retirement System

RE: 1999 ACTUARIAL EXPERIENCE ANALYSIS

Dear Members of the Board:

The Actuarial Valuations performed as of June 30, 1999, will become the cornerstone for analyzing the funding status of the System's Defined Benefit (DB) Program and Cash Balance Benefit (CBB) Program. Additional actuarial information will be developed for disclosing employer liabilities on financial statements, and for analyzing the fiscal impact of proposed legislative amendments.

The purpose of this report is to communicate the results of our review of the methods and assumptions to be used in the completion of the upcoming valuations. We are seeking your approval of the recommendations presented in this report. Some of our recommendations represent changes from the prior methods or assumptions, and are designed to better anticipate the emerging experience of the System.

We look forward to our discussions and the opportunity to respond to your questions and comments at your next meeting.

Respectfully submitted,

Mark O. Johnson, F.S.A.
Consulting Actuary

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EXECUTIVE SUMMARY

PURPOSE OF THE STUDY

The purpose of an actuarial valuation is to provide a timely best estimate of the ultimate costs of a retirement system in order to allocate them to the appropriate generations of taxpayers. To ensure that the revenue is sufficient, the actuarial valuation must be predicated on methods and assumptions that will foretell the future obligations of the system in a reasonably accurate manner.

The purpose of this study is to recommend a set of methods and assumptions for the 1999 Actuarial Valuations of the Defined Benefit (DB) Program and the Cash Balance Benefit (CBB) Program. These methods and assumptions have been developed in accordance with generally recognized and accepted actuarial principles and practices that are consistent with the applicable Standards of Practice adopted by the Actuarial Standards Board of the American Academy of Actuaries.

ORGANIZATION OF THE REPORT

The actuarial valuation utilizes various methods and two different types of assumptions: economic and demographic. Economic assumptions are related to the general economy and its impact on CalSTRS, or to the operation of the membership. Demographic assumptions predict the future experience of the membership with respect to eligibility and benefits, and are directly related to the specific experience of CalSTRS members.

All of the methods and assumptions that will be used in the 1999 Actuarial Valuations have been reviewed in this study. The report is organized in the following manner:

Section 2	Actuarial Methods
Section 3	Economic Assumptions
Section 4	Demographic Assumptions
Section 5	Impact of the Recommended Revisions to the Methods and Assumptions

SUMMARY OF RECOMMENDED METHODS AND ASSUMPTIONS

Actuarial Methods: All of the actuarial methods were reviewed and concluded to be appropriate. However, we have provided an analysis of several alternatives to the current Asset Valuation Method for the DB Program.

Economic Assumptions: The two major economic assumptions are investment return and wage growth and each is affected by the underlying assumed rate of inflation. We are recommending a reduction in the assumed rate of inflation from 4.5% to 3.5%. In addition, we are recommending an increase in the assumed real rate of investment return and a slight decrease in the productivity element of wage growth. Our recommendations are as follows.

	Current	Recommended
Inflation	4.50%	3.50%
Real Rate of Return	3.50	4.50
Investment Return	8.00%	8.00%
Inflation	4.50%	3.50%
Productivity/Real Wage Growth	1.00	0.75
Wage Growth	5.50%	4.25%

Demographic Assumptions: We are recommending minor revisions to most of the demographic assumptions. The expected net impact on the valuation of all of the demographic recommendations is very minor.

For two important demographic assumptions, we are recommending more major changes. Their fiscal impacts offset each other. We are recommending a reduction in the rate of withdrawal (which increases costs) and a reduction in the rate of retirement at the eligibility ages (which decreases costs).

SECTION 2
ACTUARIAL METHODS

This section describes the actuarial cost method and the asset valuation method that are used to process the data, and calculate the Normal Cost and funded status of each program.

Actuarial Cost Methods	
DB Program	Entry Age
CBB Program	Traditional Unit Credit
Asset Valuation Methods	
DB Program	Cumulative Expected Value with 25% Recognition of Gains and Losses
CBB Program	Fair Market Value

We are comfortable with the current methods shown above, but nevertheless, we have provided an analysis of a number of different asset valuation methods for the Retirement Board to consider for the DB Program. The Board should understand the characteristics of the current method, and other acceptable methods, especially under various economic scenarios.

ACTUARIAL COST METHOD

A fundamental principal in financing the liabilities of a retirement system is that the cost of the benefits should be related to when those benefits are earned, rather than when they are paid. There are a number of methods in use for making such a determination. We recommend that the current methods be retained for both the DB Program and the CBB Program.

DB Program: The most common actuarial cost method, and the one that has been used for many years for the DB Program actuarial valuations is technically referred to as the Entry Age Actuarial Cost Method. In our opinion, the Entry Age Method is the most appropriate method for a public system with benefits based on a final average salary. The primary reason is that, given reasonable assumptions, this method is designed to produce stable contributions as a percent of future salaries. It is not surprising that a recent survey by the Public Pension Coordinating council indicated that the vast majority of statewide retirement systems use this actuarial cost method.

There are several elements of the cost method that determine how it is applied.

- **Entry Age:** The ages at entry of future active members are assumed to average the same as the entry ages of the present active members they replace. If the number of active members should increase (or decrease), it is further assumed that the average entry age of the larger (or smaller) group will be the same, from an actuarial standpoint, as that of the present active group. Under these assumptions, the Normal Cost Rates will not vary with the termination of the present active membership.

- **Normal Cost Rate:** The present value, at entry into the Program, of all possible benefits payable from the Program, divided by the present value of expected future compensation for the new Member is called the Normal Cost Rate. The Normal Cost Rate is calculated for the benefits currently available to new entrants.

- **Actuarial Obligation:** The Actuarial Obligation is the portion of the present value of all projected benefits that is not provided for by future Normal Costs. The **Unfunded Actuarial Obligation** is the excess of the Actuarial Obligation over the Actuarial Value of Assets. If the Assets exceed the Actuarial Obligation, the difference is called the **Actuarial Surplus**.

- **Amortization:** Since the contributions to the DB Program are defined in the statutes, the actuarial valuation determines the number of years required to fund (or amortize) the Unfunded Actuarial Obligation (or Actuarial Surplus).

CBB Program: The current actuarial cost method for the CBB Program is called the Traditional Unit Credit Actuarial Cost Method.

The obligations of the CBB Program are directly related to the nominal account balances, which include the accumulation of the member and employer contributions with interest determined by the Retirement Board.

- **Normal Cost Rate:** The Normal Cost Rate reflects the value of benefits expected to accrue within one year from the valuation date. This is equal to the expected member and employer contributions for the year.

- **Actuarial Obligation:** The Actuarial Obligation is equal to the present value of the benefits accrued as of the valuation date. If the assumed future interest credits to member accounts is equivalent to the assumed investment return, then the Actuarial Obligation is equal to the sum of the members' nominal account balances, plus the Annuitant Reserve, if any. The **Unfunded Actuarial Obligation** is equal to the excess of the Actuarial Obligation over the Actuarial Value of Assets.

- **Gain and Loss Reserve:** The funding method includes a Gain and Loss Reserve which may be used to alleviate short-term volatility in the actual rates of return. The Retirement Board may elect to adopt Additional Interest Credits based on the funded status of the Program, including the value of the Gain and Loss Reserve, if any.

ASSET VALUATION METHOD

The valuation of assets for the actuarial valuation can be thought of in a different light than the valuation for a financial statement. The purpose in a financial statement disclosure is to make a representation of the current value of the assets, usually on a fair market value basis. Because the underlying calculations in the actuarial valuation are long-term in nature, and one of the goals of the valuation process is to ensure funding stability, it can be advantageous to smooth out short-term fluctuations in the market value of the System's assets.

The actuarial asset method determines the portion of the accumulated investment gains or losses that should be used to determine the funded status of the system. Using the unadjusted market value as of a single point in time, such as the valuation date, can lead to unwanted volatility in the funded status.

DB Program: The current asset smoothing method was adopted by the Retirement Board for the 1995 Actuarial Valuation, including a fresh start at Fair Market Value as of July 1, 1993. The method projects an Expected Value of Assets using the assumed rate of investment return. One-fourth of the difference between the Expected Value of Assets and the Fair Market Value is recognized in the Actuarial Value of Assets. The following table shows the calculation of the Actuarial Value of Assets under the current Expected Value Method.

($Millions)	**1997**	**1998**	**1999**
Beginning of Year	$ 60,683	$ 68,084	$ 77,565
Contributions	3,318	3,679	3,250
Benefits	(3,015)	(3,209)	(3,463)
Expected Return at 8%	4,867	5,466	6,197
Expected Value of Assets (EVA)	$ 65,883	$ 74,020	$ 83,549
Fair Market Value (FMV)	**$ 74,778**	**$ 88,198**	**$ 99,785**
Difference (FMV – EVA)	$ 8,925	$ 14,178	$ 16,236
1/4 of Difference	$ 2,231	$ 3,545	$ 4,059
Actuarial Value of Assets (AVA) { EVA + 1/4 (FMV – EVA) }	**$ 68,084**	**$ 77,565**	**$ 87,608**
AVA / FMV Ratio	***91%***	***88%***	***88%***

The current method is generally a good method, but we are recommending you consider an alternative. One of the drawbacks to the current method is that, even if the returns emerge exactly as assumed, the Actuarial Value of Assets will approach, but never reach, the full Fair Market Value. The method is similar to the situation of periodically stepping 25% toward a wall. Although you get closer and closer, you never fully reach the wall.

There is another popular method that is also consistent with a goal of stability in the funded status, however, the Actuarial Value of Assets will reach the Fair Market Value at the end of the smoothing period if the returns emerge as assumed. This method compares the expected market value to the actual market value each year. The gain or loss from the level expected is then recognized in equal dollar amounts over the subsequent smoothing period. This is a common method with the recognition usually occurring over a three to five year period.

For example, the following tables illustrate the calculation of the Actuarial Value of Assets as of June 30, 1999 under the alternative method with a five-year smoothing period.

($Millions)	Cash Flow	Expected Value	Market Value	Gain or Loss	Reserve Factor	Smoothing Reserve
1993-94			$ 47,631			
1994-95	$ 163	$ 51,850	55,862	$ 4,012	0%	$ 0
1995-96	130	60,466	63,455	2,989	20%	598
1996-97	303	68,847	74,778	5,931	40%	2,372
1997-98	470	81,249	88,198	6,949	60%	4,170
1998-99	(213)	95,032	99,785	4,753	80%	3,802
						$ 10,941

Fair Market Value June 30, 1999	**$99,785**
Asset Smoothing Reserve	(10,941)
Actuarial Value of Assets	**$88,844**
AVA / FMV Ratio	***89%***

The immediate impact of changing to the method illustrated above would be to increase the Actuarial Value of Assets in the 1999 valuation by $1,236 million. The long-term impact would be a more responsive method to tracking market conditions.

Each of these two methods can be adjusted by using various smoothing periods. For example, either method can be made more responsive to market fluctuations by shortening the smoothing period. The following tables illustrate the impact on the Actuarial Value of Assets under several investment return scenarios over the next four years.

Assumptions: Method applied retroactively to arrive at values on June 30, 1999
Scenario A = four average years
Scenario B = two poor years, followed by two average years
Scenario C = two good years, followed by two average years

FYE	Assumed Market Return	Fair Market Value	Actuarial Value of Assets: Current Method @ 25%	Actuarial Value of Assets: Current Method @ 33%	Actuarial Value of Assets: Alternate Method @ 4 yrs	Actuarial Value of Assets: Alternate Method @ 5 yrs	Asset Smoothing Reserve: Current Method @ 25%	Asset Smoothing Reserve: Current Method @ 33%	Asset Smoothing Reserve: Alternate Method @ 4 yrs	Asset Smoothing Reserve: Alternate Method @ 5 yrs
	Scenario A									
1999		$ 99.8	**$ 87.6**	$ 90.3	$ 91.3	$ 88.4	**$ 12.2**	$ 9.5	$ 8.5	$ 10.9
2000	8%	107.5	**97.7**	100.7	103.4	100.7	**9.9**	6.9	4.1	6.8
2001	8%	115.9	**107.9**	111.0	114.7	112.6	**8.0**	4.9	1.2	3.3
2002	8%	125.0	**118.5**	121.4	125.0	124.0	**6.5**	3.6	0.0	1.0
2003	8%	134.8	**129.5**	132.2	134.8	134.8	**5.2**	2.6	0.0	0.0
1999	*Ratio of AVA / FMV*		***88%***	*90%*	*91%*	*89%*				
2000			***91%***	*94%*	*96%*	*94%*				
2001			***93%***	*96%*	*99%*	*97%*				
2002			***95%***	*97%*	*100%*	*99%*				
2003			***96%***	*98%*	*100%*	*100%*				
	Scenario B									
1999		$ 99.8	**$ 87.6**	$ 90.3	$ 91.3	$ 88.8	**$ 12.2**	$ 9.5	$ 8.5	$ 10.9
2000	0%	99.6	**95.7**	98.0	101.4	99.1	**3.9**	1.5	(1.9)	0.4
2001	0%	99.4	**102.2**	103.6	108.1	107.2	**(2.8)**	(4.2)	(8.8)	(7.9)
2002	8%	107.9	**109.4**	110.1	113.1	114.1	**(2.3)**	(3.0)	(6.0)	(7.0)
2003	8%	115.4	**117.3**	117.6	117.4	120.2	**(1.9)**	(2.2)	(2.0)	(4.8)
1999	*Ratio of AVA / FMV*		***88%***	*90%*	*91%*	*89%*				
2000			***96%***	*94%*	*102%*	*100%*				
2001			***103%***	*96%*	*109%*	*108%*				
2002			***102%***	*97%*	*106%*	*107%*				
2003			***102%***	*98%*	*102%*	*104%*				
	Scenario C									
1999		$ 99.8	**$ 87.6**	$ 90.3	$ 91.3	$ 88.8	**$ 12.2**	$ 9.5	$ 8.5	$ 10.9
2000	16%	115.5	**99.7**	103.4	105.4	102.3	**15.8**	12.2	10.1	13.2
2001	16%	133.8	**114.0**	118.9	121.7	118.3	**19.8**	14.9	12.1	15.5
2002	8%	144.3	**128.3**	133.5	137.6	134.6	**16.0**	10.7	6.6	9.7
2003	8%	155.6	**142.6**	147.8	153.3	150.3	**13.0**	7.7	2.3	5.3
1999	*Ratio of AVA / FMV*		***88%***	*90%*	*91%*	*89%*				
2000			***86%***	*89%*	*91%*	*89%*				
2001			***85%***	*89%*	*91%*	*88%*				
2002			***89%***	*93%*	*95%*	*93%*				
2003			***92%***	*95%*	*99%*	*97%*				

The following points should be considered in a comparison of these alternatives:

- During a string of average years, the current method will be the slowest to return to market, and in fact, never gets there (*see Scenario A*). By changing the recognition factor from 25% to 33%, the current method will react more quickly, but still relatively slow.

  As expected, a longer smoothing period means gains and losses are recognized slower for the alternate method. The actuarial value of assets returns to market value in 2002 for the 4-year smoothing period, and by 2003 for the 5-year smoothing period.

- The current method with a recognition factor of 25% is slower to react to gains and losses than the current method with a revised factor of 33%. The 25% alternative has a larger negative Asset Smoothing Reserve after poor years (*Scenario B*). The 25% alternative also has a larger cushion after good investment years (*Scenario C*).

- A shorter smoothing period in the alternate method reduces the time to return to market after good or poor investment years. (*see all Scenarios*).

- If a change in the asset smoothing method results in an increase (or decrease) in the Actuarial Value of Assets, there is an equal decrease (or increase) in the Asset Smoothing Reserve. In other words, whatever the program gains in the Actuarial Value of Assets, it loses in the value of the Asset Smoothing Reserve.

All of these alternatives are acceptable asset valuation methods.

There are several ways to move from one asset method to a new method. Often the transition is made such that the impact on the funding status is minimized as much as possible. This can occur by using a mix of the old and new methods over a short transition period, or by picking an implementation year so that the new method comes close to the old method at transition.

Some retirement systems use the adoption of a new asset method as an opportunity to strengthen the funding status of the system. In this case, the new valuation would assume the actuarial value of assets is equal to market value, a fresh start approach, and will move to the new asset method gradually in subsequent valuations. Although this has the effect of immediately recognizing all previously unrecognized gains as of that date, the Asset Smoothing Reserve, the built-in cushion, is eliminated.

Our recommendation is to assume a new asset method has always been in effect prior to the new valuation (as illustrated in the previous table). The financial impact of a transition will depend on which method and what smoothing period is adopted. There is no impact on the Normal Cost Rate, but the Actuarial Obligation will decrease (or increase) depending on whether the value of the new method on June 30, 1999 is greater than (or less than) the current method.

CBB Program: The current asset method for the CBB Program is Fair Market Value. We recommend that this method be retained.

The obligations of the CBB Program are directly related to the nominal account balances, which include the accumulation of the member and employer contributions with interest determined by the Retirement Board. The funding method includes a Gain and Loss Reserve which may be used to alleviate short-term volatility in the actual rates of return.

In our opinion, the ability of the Retirement Board to manage the Gain and Loss Reserve provides sufficient relief from the short-term fluctuations of the market.

SECTION 3
ECONOMIC ASSUMPTIONS

Since the last report recommending economic assumptions was presented to the Board in 1996, the Actuarial Standards Board has adopted Actuarial Standard of Practice (ASOP) No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*. This standard provides guidance to actuaries giving advice on selecting economic assumptions for measuring obligations under defined benefit plans, such as CalSTRS. ASOP No. 27 is effective for any valuation with a measurement date on or after July 15, 1997.

Because no one knows what the future holds, the best an actuary can do is estimate possible future economic outcomes. These estimates are based on a mixture of past experience, future expectations, and professional judgment. The actuary should consider a number of factors, including the purpose and nature of the measurement, and appropriate recent and long-term historical economic data. However, the standard explicitly advises the actuary not to give undue weight to recent experience.

Recognizing that there is not one "right answer", the standard calls for the actuary to develop a best estimate range for each economic assumption, and then recommend a specific point within that range. Each economic assumption should individually satisfy this standard. Furthermore, with respect to any particular valuation, each economic assumption should be consistent with every other economic assumption over the measurement period.

In our opinion, the economic assumptions recommended in this report have been developed in accordance with ASOP No. 27. The following table shows our recommendations, and we will discuss an alternative treatment for funding administrative expenses.

	DB Program		CBB Program	
	Current	Recommended	Current	Recommended
Consumer Price Inflation	4.50%	3.50%	4.50%	3.50%
Investment Return	8.00%	8.00%	7.00%	8.00%
Interest on Member Accounts	6.00%	6.00%	7.00%	8.00%
Wage Growth	5.50%	4.25%	5.50%	4.25%
Administrative Expenses	0.25% of pay	0.25% of pay	none	none

CONSUMER PRICE INFLATION

Use in the Valuation: Future price inflation has an indirect impact on the results of the actuarial valuation through the development of the assumptions for future cost-of-living adjustments, investment returns and wage growth.

The current assumption for inflation is 4.5% per year.

Historical Perspective: We have used certain published economic statistics that have been accumulated on a monthly basis from 1926 through 1999. The data for inflation is based on the national Consumer Price Index, US City Average, All Urban Consumers (CPI). The data for periods ending in June of each year is documented in Exhibit 3.1. The compounded annual inflation rate for the period from 1926 through 1999 is 3.1%.

There are numerous ways to review this data. The tables below show the compounded annual inflation rate for various ten-year periods, and for longer periods ended in June of 1999.

Decade	CPI	CCPI
1989-99	3.0%	2.7%
1979-89	5.6	6.1
1969-79	7.0	7.0
1959-69	2.3	2.4
1949-59	2.0	

Period	CPI	CCPI
1989-99	3.0%	2.7%
1979-99	4.2	4.4
1969-99	5.2	5.3
1959-99	4.5	4.5
1949-99	4.0	n/a
1926-99	3.1	n/a

It is interesting, but not critical in the global sense of the economy, to look at inflation rates in the State of California (CCPI). We have inflation statistics back to 1955 on the CCPI, and find that there have been variances from the national CPI over short periods. However, the average increases over long periods of time are very close.

Historically, a somewhat different picture is seen by splitting the period into several segments. For example, the CPI had a value of 17.6 in June of 1944 compared to a value of 17.7 in June of 1926. Although there was some modest inflation during this period, there were also years of deflation. Over this entire 18 year period, inflation was essentially 0%.

The compounded annual rate of inflation between 1944 and 1999 was 4.2% per year. Over the last fifteen years, the annual rate has come down to 3.2%, which is closer to the average from 1926. However, the previous fifteen-year period included a few years of unusually high inflation in the 1970's, resulting in a significantly higher average of 7.2% for that period.

Inflation has historically varied over long periods: for example, the period from 1926 to 1944 with virtually no inflation, a period of high inflation in the 1970's, and most recently relatively low inflation averaging about 2.5% over the last eight years.

Forecasts of Inflation: Since the U.S. Treasury started issuing inflation indexed bonds, it is possible to determine the approximate rate of inflation anticipated by investors by comparing the yields on inflation indexed bonds with traditional fixed government bonds. Current market prices suggest investors expect inflation of about 2% over the next five to ten years.

Most economists forecast inflation lower than the current assumption of 4.5%. For example, the *Standard & Poor's DRI Review of the U.S. Economy* estimates a long-term perspective on future inflation. The current 25-year trend forecast predicts that the CPI will rise 3.4% annually over the next 25 years.

Reasonable Range and Recommendation: We believe that the current assumption of 4.5% per year is outside a reasonable range for the long-term future. In our opinion, a range between 3.0% and 4.2% is reasonable for an actuarial valuation of a retirement system. We recommend that the long-term assumed inflation rate be lowered from 4.5% to 3.5% per year.

Consumer Price Inflation	
Current Assumption	4.5%
Reasonable Range	3.0% - 4.2%
Recommended Assumption	3.5%

INVESTMENT RETURN

Use in the Valuation: The investment return assumption is one of the primary determinants in the calculation of the expected cost of the System's benefits, providing a discount of the future benefit payments reflecting the time value of money. Due to different asset allocation policies, the assumption is studied separately for the Defined Benefit Program and the Cash Balance Program.

The current investment return assumption for the DB Program is 8.0% per year, net of all investment-related expenses. The current assumption in the CBB Program is 7.0% per year.

Historical Perspective: One of the inherent problems with analyzing historical data is that the results can look significantly different depending on the time frame used if the year-to-year results tend to vary widely. For example, the unusually high equity returns over the last three or four years have had a remarkable impact on rolling ten-year period returns. Furthermore, the approach we used to predict inflation does not necessarily reflect current expectations for the capital markets. Even though history provides a valuable perspective for setting this assumption, the economy of the past is not today's economy.

Projection Model using Capital Market Assumptions: In our opinion, a better approach builds upon the latest capital market assumptions developed by the Retirement Board's investment advisor, Pension Consulting Alliance, Inc. We have documented these assumptions in Exhibit 3.3. A formula-based model was used to predict future returns based on these capital market assumptions, the asset allocation policy, and assumed annual rebalancing. The asset allocation and the expected real returns and total returns by asset class are shown below.

Asset Class	Asset Allocation Policy		Real Rate of Return	Standard Deviation
	DB Program	CBB Program		
US Equities	38%	60%	7.25%	20.00%
International Equities	25	0	7.40	22.00
Real Estate	5	0	6.00	12.00
Alternative Investments	5	0	11.25	30.00
US Fixed Income	26	40	3.00	10.00
Cash	1	0	1.50	1.50

The capital market assumptions were combined with the Board's asset allocation policy to generate expected returns over a thirty-year period. The model assumes that investment returns are lognormally distributed and is based on mathematical formulas from *The Long-Term Expected Rate of Return: Setting It Right* by Olivier de la Grandville as published in the Financial Analysts Journal, Nov/Dec 1998.

Projected Returns for the DB Program: The expected real rate of return of a portfolio allocated according to current policy is 6.26% for one year, 9.76% including the assumed inflation rate of 3.5%. However, the return is subject to significant volatility. The model provides a guide to see if it is reasonable to expect this return to compound over longer periods of time. The results are summarized below, showing expected real rates of return up to 30 years.

Horizon in Years	Mean	Std Dev	Percentile Results 5th	25th	50th	75th	95th
1	6.3%	12.6%	-13.2%	-2.6%	5.5%	14.3%	28.2%
5	5.7	5.6	-3.3	1.8	5.5	9.4	15.1
10	5.6	4.0	-0.8	2.9	5.5	8.2	12.2
20	5.6	2.8	1.0	3.7	5.5	7.4	10.2
30	5.5	2.3	1.8	**4.0**	**5.5**	**7.1**	9.3

In the first year, the mean real return is 6.26%, but due to the volatility associated with the asset allocation, the range of probable outcomes is quite large. For example, in the first year there is a 5% chance the real rate of return will be less than -13.2% and a 5% chance it will be greater than 28.2%. As the time horizon lengthens, the range of cumulative average results narrows.

Over a thirty-year time horizon, there is a 25% chance the real rate of return will be less than 4.0% and a 25% chance the return will be greater than 7.1% (bold numbers on the bottom line in the table above). Therefore, we can say the return is just as likely to be within the range from 4.0% to 7.1% as not. The median real return over thirty years is expected to be 5.5%.

Projected Returns for the CBB Program: The expected real rate of return of a portfolio allocated according to current policy is 5.55% for one year, 9.05% including the assumed inflation rate of 3.5%. The expected real rates of return are summarized in the following table.

Horizon in Years	Mean	Std Dev	Percentile Results 5th	25th	50th	75th	95th
1	5.6%	14.6%	-16.6%	-4.7%	4.6%	14.7%	31.1%
5	4.8	6.5	-5.5	0.3	4.6	9.0	15.7
10	4.7	4.6	-2.7	1.5	4.6	7.7	12.3
20	4.6	3.2	-0.6	2.4	4.6	6.8	10.0
30	4.6	2.6	0.3	**2.8**	**4.6**	**6.3**	9.0

Over a thirty-year time horizon, there is a 25% chance the real rate of return will be less than 2.8% and a 25% chance the return will be greater than 6.3% (bold numbers on the bottom line in the table above).

Therefore, we can say the return is just as likely to be within the range from 2.8% to 6.3% as not. The median real return over thirty years is expected to be 4.6%.

Investment-Related Expenses: The investment return is assumed to be net of all investment-related expenses. Since the CBB Program fund is invested in pools, we expect the investment-related expenses to be negligible. The following table below shows the ratio of investment expenses to DB Program assets over the last ten years. The expense ratio is calculated as the total expense divided by the beginning asset balance at market value.

($million)	Investment Expenses.	DB Program Assets	Expense Ratio
1990	$ 15.9	$ 32,431	0.05%
1991	19.0	35,565	0.05
1992	20.5	41,130	0.05
1993	26.5	47,122	0.06
1994	32.1	47,631	0.07
1995	36.8	55,862	0.07
1996	41.0	63,455	0.06
1997	43.4	74,778	0.06
1998	40.6	88,198	0.05
1999	45.0	99,785	0.05

The expenses for the Securities Lending Program are shown with other investment related expenses in the System's financial statements. Since this expense is not related to the income from the invested assets, we have excluded these costs. Based on this data, it appears the investment expenses represent about 0.05% of the DB Program assets.

Reasonable Range and Recommendations: Based on the ASOP No. 27 guidelines, we conclude that the reasonable range is the expected real rates of return between the 25th and 75th percentile projected out 30 years, plus the assumed inflation rate, less investment expenses.

	Percentile Results					
	DB Program			CBB Program		
Components of Return	**25th**	**50th**	**75th**	**25th**	**50th**	**75th**
Real Rate of Return	3.99%	5.52%	7.07%	2.80%	4.56%	6.34%
Assumed Inflation	3.50	3.50	3.50	3.50	3.50	3.50
Investment Expenses	(0.05)	(0.05)	(0.05)	(0.00)	(0.00)	(0.00)
Net Investment Return	7.44%	8.97%	10.52%	6.30%	8.06%	9.84%

The range of expected returns for the DB Program is somewhat higher than the range for the CBB Program because of the greater allocation of DB Program assets to classes with higher expected rates of return. The international equities, real estate and alternative investment classes account for 35% of the DB Program allocation, while none of the CBB Program assets are allocated to these classes. Along with the higher expected returns comes a higher degree of risk.

Although our projections indicate a higher expected return in the DB Program, we are recommending that the net investment return assumption be set at 8.0% per year for both the DB Program and the CBB Program. In addition to the higher degree of risk in the DB Program investments, we believe it may be appropriate to include an element of conservatism in the DB Program because of the nature of the benefits. The CBB Program benefits will ultimately be based on the assets in the fund, including the actual investment return (the member account balance), while the DB Program benefits will ultimately be based on a number of parameters that are unknown, and will be unknown for many years to come.

Investment Return

	DB Program	CBB Program
Current Assumption	8.00%	7.00%
Reasonable Range		
Real Rate of Return	3.99% - 7.07%	2.80% - 6.34%
Assumed Rate of Inflation	3.50 - 3.50	3.50 - 3.50
Provision for Expenses	(0.05) - (0.05)	(0.00) - (0.00)
Net Investment Return	7.44% - 10.52%	6.30% - 9.84%
Recommended Assumption	8.00%	8.00%

Even though we are recommending the assumed return for the DB Program remain at 8.00%, it is important to point out that the underlying real rate of return is being increased by 1.00% which is offset by a reduction in the underlying rate of inflation.

Although not used to derive the investment return assumption, the following statistics are presented to show that the assumption of 8.0% is not unusually high, nor unusually low, when compared with the assumptions made by other public systems.

- The Public Pension Coordinating Council's survey of public employee retirement systems showed that the average assumed rate of return from the latest available actuarial reports was 7.84% for all systems, and 8.11% for the 29 systems with assets greater than $10 billion.

- The biennial comparative study performed by the State of Wisconsin on 84 statewide systems showed a range from 7.0% through 9.0%, with an average of 8.0%. The rates of return were widely distributed, with over half of the systems using 8.0%, 20% using 7.5% and 20% using 8.5%.

INTEREST ON MEMBER ACCOUNTS

Use in the Valuation: This assumption is used to predict the level of future member account balances. In the DB Program, the account balance may be refunded upon termination of membership. In the CBB Program, all benefits are dependent on the level of the account balance. Therefore, the assumption is much more critical in the CBB Program valuation. The current assumption is 6.0% per year for the DB Program, and 7.0% per year for the CBB Program.

DB Program: The Board's policy is to credit interest to member accounts in an amount to be calculated annually based on the rate paid on two-year Treasury notes for the previous twelve months. The rate can go no higher than the actuarial assumed investment return, nor lower than a current passbook rate.

In light of this policy, the assumption has been set equal to the assumed increase in the Consumer Price Index plus a margin to reflect the yield on two-year Treasuries. The following table shows the average excess yield of two-year Treasuries over inflation to be between 3.0% and 3.7% for the last six years.

	CPI	2-Yr Treas.	Excess
1994	2.5%	5.9%	3.4%
1995	3.0	6.2	3.2
1996	2.8	5.8	3.0
1997	2.3	6.0	3.7
1998	1.7	5.1	3.4
1999	2.0	5.4	3.4

Prior to 1994, the excess of the yield on two-year Treasuries over inflation was significantly less than shown above. In fact, the current assumption is 1.5% above inflation. Given the fact that the two-year Treasury rates have been unusually high relative to inflation the last few years, we are recommending that the assumption remain at 6.0%, which is 2.5% above the recommended inflation assumption.

CBB Program: The Board's policy is to credit interest to member accounts based on the statutory minimum rate for the year, plus a portion of the returns in excess of the statutory minimum. The Board has the authority to establish a reserve for short-term fluctuations in the actual returns from year to year so that the minimum credit can be allocated from current invested assets. Nevertheless, the long-term intention is to allocate all of the investment earnings to the member accounts. Therefore, the assumed long-term credit to member accounts should be equal to the assumed long-term expected return for the CBB Program, or 8.0% per year.

Recommendations: Our recommended assumptions are shown in the following table.

Interest on Member Accounts		
	DB Program	**CBB Program**
Current Assumption	6.0%	7.0%
Recommended Assumption	6.0%	8.0%

WAGE GROWTH

Use in the Valuation: Estimates of future salaries are based on two types of assumptions. Rates of increase in the general wage level of the membership are directly related to inflation, while individual salaries due to promotion and longevity occur even in the absence of inflation. The promotion and longevity assumptions, referred to as the merit scale, will be reviewed with the other demographic assumptions.

The current wage growth assumption is 1.0% above the inflation assumption, or 5.5% per year.

Historical Perspective: We have used statistics from the Social Security System on the National Average Wage back to 1951. For years prior to 1951, we studied the Total Private Nonagricultural Wages as published in *Historical Statistics of the U.S., Colonial Times to 1970*. The data for each year is documented in Exhibit 2.4. This data shows a compounded annual increase from 1926 through 1998 of 4.6%.

There are numerous ways to review this data. For consistency with our observations of other indices, the table below shows the compounded annual rates of wage growth for various ten-year periods, and for longer periods ended in June of 1998. Wage data for 1999 is not yet available.

Decade	Wages	CPI	Prod.
1988-98	4.1%	3.3%	0.8%
1978-88	6.2	6.1	0.1
1968-78	6.6	6.5	0.1
1958-68	4.3	1.8	2.4
1948-58	4.5	1.8	2.6

Period	Wages	CPI	Prod.
1988-98	4.1%	3.3%	0.8%
1978-98	5.2	4.7	0.5
1968-98	5.6	5.3	0.3
1958-98	5.3	4.4	0.9
1948-98	5.1	3.9	1.2
1926-98	4.6	3.1	1.5

The excess of wage growth over price inflation represents the increase in the standard of living, also called productivity, or real wage growth. There has been debate on the issue of whether public sector employees will receive, over the long term, the same rewards for productivity as employees in the private sector, where productivity is more readily measurable. To my knowledge, no definitive research has been completed on this topic. Nevertheless, it is my opinion that public sector employees must be rewarded, even if there is a time lag, with the same productivity increases as those participating in the remainder of the economy.

Wage growth is not as volatile as investment returns, so the limitations that were discussed regarding the historical method for predicting future investment returns are not as severe. Since we have not modeled future wage growth using the more sophisticated approach used to project future investment returns, we

are relying on the historical method to develop the wage growth assumption. We are comfortable with this approach.

We also looked at the average CalSTRS Earnable Salary over the last 25 years. The table below shows the Earnable Salary and the annual rates of increase for the five-year periods and cumulative periods.

FYE	Earnable
1999	$45,421
1994	40,180
1989	36,332
1984	26,479
1979	18,725
1974	13,440

Period	Increase
1994-99	2.5%
1989-94	2.0
1984-89	6.5
1979-84	7.2
1974-79	6.9

Period	Increase
1994-99	2.5%
1989-99	2.3
1984-99	3.7
1979-99	4.5
1974-99	5.0

It is important to note that the periods with the highest increases in the average Earnable Salary were also during or shortly after periods of high inflation. These averages are not as reliable as more global statistics, since they include the influence of a change in the number of members from one point to another.

Reasonable Range and Recommendation: Based on our judgment, we believe that a range between 3.0% and 5.2% is reasonable for the actuarial valuation. The range was developed by taking the range for inflation (3.0% to 4.2%) and adding 1.0% for productivity at the high end. Based on this data, we recommend that the long-term assumed wage inflation rate be lowered from 5.5% to 4.25 % per year to reflect the decrease of 1.0% per year in the assumed rate of inflation, and a decrease in the assumed rate of real wage growth from 1.0% to 0.75% per year.

Wage Growth			
Current Assumption	5.50%		
Reasonable Range			
Assumed Rate of Inflation	3.0%	-	4.2%
Real Wage Growth	0.0	-	1.0
Wage Growth	3.0%	-	5.2%
Recommended Assumption	4.25%		

ADMINISTRATIVE EXPENSES

Use in the Valuation: The Normal Cost Rate for the DB Program includes a provision for administrative expenses, expressed as a percentage of the System payroll. Thus, expenses are assumed to be paid from current year DB Program contributions.

Historical Perspective: Administrative expenses have been expressed as a percentage of the System payroll for many years. History has shown that this has been an appropriate method of recognizing expenses for the DB Program. The table below shows the ratio of administrative expenses to payroll over the last ten years.

($million)	Administrative Expenses	Covered Payroll	Expense Ratio
1990	$ 21.8	$ 10,725	0.20%
1991	27.5	11,476	0.24
1992	27.5	11,729	0.23
1993	31.1	11,712	0.27
1994	31.1	11,978	0.26
1995	34.0	12,411	0.27
1996	36.2	12,995	0.28
1997	37.1	14,371	0.26
1998	36.3	15,726	0.23
1999	45.0	17,008	0.26

Recommendations: The current assumption is that 0.25% of payroll will be sufficient to provide for future administrative expenses. After reviewing the trend above and considering the fact that wage increases have been relatively low recently, we recommend that this assumption be retained at 0.25% of payroll.

Administrative Expenses		
	DB Program	CBB Program
Current Assumption	0.25% of payroll	none
Recommended Assumption	0.25% of payroll	none

Alternative Approach: Beginning in 1999, the administrative expenses of the CBB Program are being allocated along with the administrative expenses of the DB Program based on each program's assets. We believe the Retirement Board should consider a policy change to assume that future DB

administrative expenses will be funded from investment earnings in excess of the assumed rate of return. The following table shows the ratio of administrative expenses to assets.

($million)	Administrative Expenses	DB Program Assets	Expense Ratio
1990	$ 21.8	$ 32,431	0.07%
1991	27.5	35,565	0.08
1992	27.5	41,130	0.07
1993	31.1	47,122	0.07
1994	31.1	47,631	0.07
1995	34.0	55,862	0.06
1996	36.2	63,455	0.06
1997	37.1	74,778	0.05
1998	36.3	88,198	0.04
1999	45.0	99,785	0.05

Based on this data, it appears the administrative expenses represent about 0.05%of assets. Given the recommendation of the assumed rate of return of 8.00%, and the range of reasonable returns, it would be reasonable to assume that administrative expenses could be funded through investment earnings in excess of 8.00% per year. In our opinion, five fewer basis points on the range of expected returns would not change our recommendation of 8.00%.

There is a significant policy issue with respect to this alternative. The issue is whether current administrative costs should be funded by current contribution revenue, or whether the earnings on accumulated assets should support the administration of the system. Furthermore, we have not recommended a provision from current contributions to the CBB Program, therefore, the revenue from the DB Program contributions is effectively funding the CBB Program expenses.

We understand that there are accounting procedures required by statute to allocate the administrative expenses to the DB Program and the CBB Program based on the assets in each program. However, it is our understanding that the statute does not speak to the source of revenue to fund these expenses.

It is not uncommon for retirement systems to assume that administrative expenses are funded from investment earnings. For the very large systems, administrative expenses may represent a very small percentage of the invested assets, such as 0.05% for CalSTRS.

The fiscal impact of this alternative on the System's funding would be that the Normal Cost Rate would be lower by 0.25% of payroll.

INDEX OF EXHIBITS

Exhibit 3.1 US Consumer Price Index

June of:	Index	Increase	June of:	Index	Increase
1926	17.7		1961	29.8	0.7%
1927	17.6	(0.6)%	1962	30.2	1.3
1928	17.1	(2.8)	1963	30.6	1.3
1929	17.1	0.0	1964	31.0	1.3
1930	16.8	(1.8)	1965	31.6	1.9
1931	15.1	(10.1)	1966	32.4	2.5
1932	13.6	(9.9)	1967	33.3	2.8
1933	12.7	(6.6)	1968	34.7	4.2
1934	13.4	5.5	1969	36.6	5.5
1935	13.7	2.2	1970	38.8	6.0
1936	13.8	0.7	1971	40.6	4.6
1937	14.4	4.3	1972	41.7	2.7
1938	14.1	(2.1)	1973	44.2	6.0
1939	13.8	(2.1)	1974	49.0	10.9
1940	14.1	2.2	1975	53.6	9.4
1941	14.7	4.3	1976	56.8	6.0
1942	16.3	10.9	1977	60.7	6.9
1943	17.5	7.4	1978	65.2	7.4
1944	17.6	0.6	1979	72.3	10.9
1945	18.1	2.8	1980	82.7	14.4
1946	18.7	3.3	1981	90.6	9.6
1947	22.0	17.6	1982	97.0	7.1
1948	24.1	9.5	1983	99.5	2.6
1949	23.9	(0.8)	1984	103.7	4.2
1950	23.8	(0.4)	1985	107.6	3.8
1951	25.9	8.8	1986	109.5	1.8
1952	26.5	2.3	1987	113.5	3.7
1953	26.8	1.1	1988	118.0	4.0
1954	26.9	0.4	1989	124.1	5.2
1955	26.7	(0.7)	1990	129.9	4.7
1956	27.2	1.9	1991	136.0	4.7
1957	28.1	3.3	1992	140.2	3.1
1958	28.9	2.8	1993	144.4	3.0
1959	29.1	0.7	1994	148.0	2.5
1960	29.6	1.7	1995	152.5	3.0
			1996	156.7	2.8
			1997	160.3	2.3
			1998	163.0	1.7
			1999	166.2	2.0

Exhibit 3.2 California Consumer Price Index

June of:	Index	Increase	June of:	Index	Increase
1955	25.6				
1956	26.2	2.4%	1976	55.2	6.2%
1957	27.1	3.4	1977	59.5	7.8
1958	28.1	3.7	1978	64.6	8.6
1959	28.5	1.4	1979	71.0	9.9
1960	29.1	2.1	1980	83.3	17.3
1961	29.5	1.4	1981	90.1	8.2
1962	30.0	1.7	1982	98.5	9.3
1963	30.2	0.7	1983	99.1	0.6
1964	30.8	2.0	1984	103.6	4.5
1965	31.6	2.6	1985	108.4	4.6
1966	32.1	1.6	1986	112.2	3.5
1967	32.9	2.5	1987	116.3	3.7
1968	34.3	4.3	1988	121.7	4.6
1969	36.0	5.0	1989	128.2	5.3
1970	37.9	5.3	1990	134.3	4.8
1971	40.5	4.0	1991	140.1	4.3
1972	42.7	2.8	1992	145.2	3.6
1973	47.1	5.4	1993	148.9	2.5
1974	52.0	10.3	1994	150.7	1.2
1975		10.4	1995	154.2	2.3
			1996	156.6	1.6
			1997	160.0	2.2
			1998	163.6	2.3
			1999	167.8	2.6

Exhibit 3.3 **Capital Market Assumptions**

Asset Class	Expected Real Return	Standard Deviation
Cash Equivalents	1.50%	1.5%
US Fixed Income	3.00	10.0
US Equities	7.25	20.0
International Equities	7.40	22.0
Alternative Investments	11.25	30.0
Real Estate	6.00	12.0

	Cross Correlation Matrix					
Asset Class	**Cash**	**US Fixed**	**US Eqty**	**Intl Eqty**	**Alt Inv**	**RE**
Cash	1.00					
US Fixed Income	0.15	1.00				
US Equities	0.40	0.55	1.00			
Int'l Equities	0.00	0.20	0.20	1.00		
Alt. Invest.	0.10	0.15	0.40	0.15	1.00	
Real Estate	0.10	0.15	0.20	0.20	0.85	1.00

Source: Pension Consulting Alliance, Inc. (December 23, 1999)

Exhibit 3.4

Wage Index

June of:	Index	Increase	June of:	Index	Increase
1926	$1,130.11		**1961**	$4,086.76	2.0%
1927	1,159.14	2.6%	**1962**	4,291.40	5.0
1928	1,162.53	0.3	**1963**	4,396.64	2.5
1929	1,196.88	3.0	**1964**	4,576.32	4.1
1930	1,164.95	(2.7)	**1965**	4,658.72	1.8
1931	1,086.09	(6.8)	**1966**	4,938.36	6.0
1932	954.02	(12.2)	**1967**	5,213.44	5.6
1933	892.58	(6.4)	**1968**	5,571.76	6.9
1934	929.34	4.1	**1969**	5,893.76	5.8
1935	968.53	4.2	**1970**	6,186.24	5.0
1936	1,008.20	4.1	**1971**	6,497.08	5.0
1937	1,071.58	6.3	**1972**	7,133.80	9.8
1938	1,047.39	(2.3)	**1973**	7,580.16	6.3
1939	1,076.41	2.8	**1974**	8,030.76	5.9
1940	1,106.41	2.8	**1975**	8,630.92	7.5
1941	1,228.81	11.1	**1976**	9,226.48	6.9
1942	1,455.70	18.5	**1977**	9,779.44	6.0
1943	1,661.79	14.2	**1978**	10,556.03	7.9
1944	1,796.28	8.1	**1979**	11,479.46	8.7
1945	1,865.46	3.9	**1980**	12,513.46	9.0
1946	2,009.14	7.7	**1981**	13,773.10	10.1
1947	2,205.08	9.8	**1982**	14,531.34	5.5
1948	2,370.53	7.5	**1983**	15,239.24	4.9
1949	2,430.52	2.5	**1984**	16,135.07	5.9
1950	2,570.33	5.8	**1985**	16,822.51	4.3
1951	2,799.16	8.9	**1986**	17,321.82	3.0
1952	2,973.32	6.2	**1987**	18,426.51	6.4
1953	3,139.44	5.6	**1988**	19,334.04	4.9
1954	3,155.64	0.5	**1989**	20,099.55	4.0
1955	3,301.44	4.6	**1990**	21,027.98	4.6
1956	3,532.36	7.0	**1991**	21,811.60	3.7
1957	3,641.72	3.1	**1992**	22,935.42	5.2
1958	3,673.80	0.9	**1993**	23,132.67	0.9
1959	3,855.80	5.0	**1994**	23,753.53	2.7
1960	4,007.12	3.9	**1995**	24,705.66	4.0
			1996	25,913.90	4.9
			1997	27,426.00	5.8
			1998	28,861.44	5.2

SECTION 4
DEMOGRAPHIC ASSUMPTIONS

The purpose of a study of demographic experience is to compare what happened to the membership during the study period (July 1, 1995, through June 30, 1999) with what was expected to happen based on the assumptions used in the most recent Actuarial Valuation. Studies of demographic experience involve several steps.

- First, the number of members changing membership status, called decrements, during the study are tabulated by entry age, attained age, duration or sex, or a combination of these.
- Next, the number of members expected to change status is calculated by multiplying certain membership statistics, called the exposure, by the expected rates of decrement.
- Then, the number of actual decrements are compared with the number of expected decrements. The comparison is called the actual to expected ratio (A/E Ratio).

If the actual experience differs significantly from the overall expected results, or if the pattern of actual decrements, or rates of decrement, by age, sex, or duration does not follow the expected pattern, new assumptions are considered. Recommended revisions normally are not an exact representation of the experience during the observation period. Judgment is required to predict future experience from past trends and current evidence, including a determination of the amount of weight to assign to the most recent experience.

Revised rates of decrement are tested by using them to recalculate the expected number of decrements during the study period, and the results are shown as revised A/E Ratios.

The remainder of this section presents the results of the demographic study. We have prepared tables that show a comparison of the actual and expected decrements and the overall ratio of actual to expected results under the current assumptions. If a change is being proposed, the revised A/E Ratios are shown as well.

Salary adjustments, other than the economic assumption for wage inflation, are treated as demographic assumptions. However, a different method of investigation is needed for salaries than is used for the decrements. These adjustments have been analyzed with historical data as described later in this section.

MORTALITY

Retirees: Mortality has been improving in this country throughout the century with dramatic improvements at pre-retirement ages. Mortality has also been improving at the retired ages and recent experience studies have shown this to be true in this System. If the actual to expected ratio (A/E) is greater than 100%, we have predicted fewer deaths, and therefore have built in some margin for future mortality improvements.

This assumption applies to the retired members only. The mortality was changed to the 1983 Group Annuity Mortality Table in 1988 to provide a closer fit by age, and the overall differences were in excess of 10%. We did not change the mortality in 1991 or 1995, but are recommending a change this time to a modification of the 1994 Group Annuity Mortality Table, published by the Society of Actuaries since the last Experience Analysis

	Number of Deaths – 1999 Study			Actual / Expected Ratio		
	Actual Number	Expected Number	Revised Expected	1995 Study	1999 Actual	1999 Revised
Male	5,474	5,746	5,372	98%	95%	102%
Female	10,204	9,420	9,703	105	108	105
Total	15,678	15,166	15,075	103%	103%	104%

We fit the 1994 GAM table to the trend in actual experience of the retired members. The age setbacks from the published tables are in parentheses following each table:

Current Assumption:	Male	1983 GAM (-3)
	Female	1983 GAM (-1)
Recommendation:	Male	1994 GAM (-3) to age 77, then graduated to 1994 GAM at age 92
	Female	1994 GAM (-2) to age 77, then graduated to 1994 GAM at age 87
Impact of Change:	The impact of this recommendation will be a slight increase in the Actuarial Obligation due to the expectation of a different pattern of mortality, including longer life expectancies, especially for males.	

The mortality experience for retired members electing different survivorship options is critical for the determination of the option factors, but has little impact on the actuarial valuation. The mortality

experience by option elected will be studied later in conjunction with a review of the actuarial equivalency factors.

We also recommend that the assumed mortality table used after retirement for currently active members be set back an additional two years from the table used for current retirees to allow for future mortality improvements. This reflects the belief that present active members will experience even lower mortality than those now retired. This is the current assumption and does not represent a change.

Beneficiaries: This assumption applies to the surviving beneficiaries of members who have elected a joint and survivor annuity. The reported deaths are only for those beneficiaries who died while receiving an allowance, that is, after the death of the member. There is not complete data on the mortality experience of beneficiaries prior to the death of the member, because there is no requirement that the death be reported to the System. The mortality of beneficiaries prior to the death of the member is more critical to the development of the option factors than to the results of the valuation.

	Number of Deaths – 1999 Study			Actual / Expected Ratio		
	Actual Number	Expected Number	Revised Expected	1995 Study	1999 Actual	1999 Revised
Male	367	383	336	112%	96%	109%
Female	1,060	1,010	1,041	102	105	102
Total	1,427	1,393	1,377	104%	102%	104%

We fit the 1994 GAM table to the trend in actual experience of the retired members. The age setbacks from the published tables are in parentheses following each table:

Current Assumption:	Male	1983 GAM (-3)
	Female	1983 GAM (-1)
Recommendation:	Male	1994 GAM (-1) to age 87, then graduated to 1994 GAM at age 92
	Female	1994 GAM (-2) to age 77, then graduated to 1994 GAM at age 87
Impact on the Valuation:	The impact of this recommendation will be a slight increase in the Actuarial Obligation due to the expectation of a different pattern of mortality, including longer life expectancies.	

Active Members: Recent experience was dramatically different than in the past two studies, due to a reduction in the rate of active member deaths. The tables were changed in 1988 to provide margins of about 5%. The chart below shows that margin has disappeared.

	Number of Deaths – 1999 Study			Actual / Expected Ratio		
	Actual Number	Expected Number	Revised Expected	1995 Study	1999 Actual	1999 Revised
Male	802	1,001	793	106%	80%	101%
Female	963	1,135	1,017	99	85	95
Total	1,765	2,136	1,810	102%	83%	98%

Our recommended revision is from the 1983 Group Annuity Mortality Table to the 1994 Group Annuity Mortality Table. The age setbacks will continue to be two years from the assumed retired mortality tables. Since the retired mortality was changed, the tables for active members will be changed as well.

Current Assumption: Two-year setback from retired mortality.

Recommendation: Two-year setback from retired mortality.

Impact on the Valuation: The impact of this recommendation will be an increase in the Actuarial Obligation due to the expectation of a greater number of members attaining retirement age.

Pre-1972 Disabled Retirees: These rates apply to the closed group of members who retired with a disability before 1972. The tables were last changed in 1988 to the 1951 Group Annuity Mortality Table with age setbacks. The following chart indicates that the current female assumption should be adjusted slightly, and we increased the age adjustment by one year.

	Number of Deaths – 1999 Study			Actual / Expected Ratio		
	Actual Number	Expected Number	Revised Expected	1995 Study	1999 Actual	1999 Revised
Male	21	22	22	109%	95%	95%
Female	139	110	119	108	126	117
Total	160	132	141	108%	121%	113%

Current Assumption: Male 1951 GAM (-1)
Female 1951 GAM (-8)

Recommendation: Male 1951 GAM (-1) no change
Female 1951 GAM (-7)

Impact on the Valuation: This minor change will have a negligible impact on the valuation since there are very few members in the group.

TERMINATION FROM DISABILITY

Members may terminate the disabled status by returning to active membership, by recovering to inactive status, or by death. The current and proposed valuation method does not call for a prediction of a return to active status. Instead, those members are assumed to remain disabled for life, and recoveries to active status are treated in the normal course of an actuarial valuation as gains and losses. The following table shows the proportion of terminations from both Coverage A and Coverage B disability that are due to these three causes.

	1995 Study		1999 Study	
	Male	Female	Male	Female
To Death	89%	73%	78%	71%
To Inactive	2	3	6	4
To Active	9	24	16	25

The rates of termination during the first three years of disability are significantly higher than normal mortality rates. Therefore, special rates are in effect for the first three years of disability, regardless of the age of the disabilitant. The recent experience shows that the select period is still very important.

		Disability Termination Rate – 1999 Study			Actual / Expected Ratio		
	Year	Actual Rate	Expected Rate	Revised Rate	1995 Study	1999 Actual	1999 Revised
Male	1	11.6%	11.4%	11.4%	100%	102%	102%
	2	5.6	7.7	7.7	100	73	73
	3	5.8	6.2	6.2	100	94	94
Number of Males		88	96	96	100%	92%	92%
Female	1	6.0%	5.9%	6.0%	100%	102%	100%
	2	3.0	4.6	3.8	100	65	79
	3	2.5	3.6	3.0	100	69	83
Number of Females		118	142	130	100%	83%	91%
Total Number		206	238	226	100%	87%	91%

We recommend revising the female rates in the first three years to partially reflect actual experience during the observation period.

The next table shows the number of actual and expected terminations after the third year of disability, excluding those who returned to active membership. Although not shown here, the fit is poor at the older ages, and a new mortality table is warranted. The revised number of expected terminations uses the 1994 GAM table with a 2.5% minimum mortality rate for males instead of the current minimum of 3.5% respectively.

	Number of Terminations – 1999 Study After 3rd Year of Disablement			Actual / Expected Ratio		
	Actual Number	Expected Number	Revised Expected	1995 Study	1999 Actual	1999 Revised
Male	151	212	171	104%	71%	88%
Female	251	260	259	104	97	97
Total	402	472	430	104%	85%	93%

We recommend a change to this basis, which partially corrects the overstatement of disability terminations in the observation period. We will watch this closely in another four years to see if further adjustments are warranted.

Current Assumption:	Male	1983 GAM (minimum of 3.5%)
	Female	1983 GAM (minimum of 2.2%)
	First 3 Yrs.	Special rates as shown
Recommendation:	Male	1994 GAM (minimum of 2.5%)
	Female	1994 GAM (minimum of 2.2%)
	First 3 Yrs.	Special rates as shown, revised for females
Impact:	The impact of this recommendation will be a slight increase in the Normal Cost Rate and Actuarial Obligation due to the expectation of fewer members terminating disablement.	

SERVICE RETIREMENT

We expected the analysis of retirement rates to provide quite a challenge in this study because of the influences the 1998 benefit changes may have had on the pattern of retirements during the period. However, we found very little evidence of variance of retirement rates within the observation period. We studied the first two years separately, and we looked at the first six months of 1999 separately, looking for changes in behavior.

We supplemented our study with month-by-month retirement statistics collected by CalSTRS staff. Again, we found almost no evidence of delayed retirements leading up to the passage of the 1998 benefits package, and almost no evidence of a surge in retirements after the effective date.

Therefore, we concluded that it would be reasonable to combine the statistics during the entire observation period for this study. As in the previous study, we did not see a significant difference in retirement experience between Coverage A and Coverage B members, so we will continue to use the same probabilities for each group.

The following table shows the actual number of retirements and the expected number based on the retirement assumptions in the last valuation. As you can see, actual retirements represented only 75% of the expected retirements.

	Number of Retirements – 1999 Study			Actual / Expected Ratio		
	Actual Number	Expected Number	Revised Expected	1995 Study	1999 Actual	1999 Revised
Male	8,988	12,542	9,343	99%	72%	96%
Female	14,632	18,858	15,817	99	78	93
Total	23,620	31,400	25,160	99%	75%	94%

We agree with Watson Wyatt, the prior actuary, that some adjustment in retirement rates will be reasonable in the future to anticipate the delayed retirement of some members who will benefit from the higher age factors after age 60, and the career bonus after thirty years. Although we only have six months of experience, and we did not see evidence of significant delays in retirement, we feel it is reasonable to assume that some delay will occur. Based on the brief observation period after the effective date of the legislation, which could have demonstrated pent-up demand and a surge of retirements for older, long-service members, we do not believe that the delays will be nearly as significant as Watson Wyatt had predicted.

The following table shows the expected number of retirements taking into account the impact of the 1998 benefits package. This analysis is used to develop the new assumptions.

	Number of Retirements – 1999 Study			Actual / Expected Ratio		
	Actual Number	Wyatt Proposed	M&R Proposed	1995 Study	Wyatt Proposed	M&R Proposed
Male	8,988	7,653	8,735	99%	117%	103%
Female	14,632	11,903	13,978	99	123	105
Total	23,620	19,556	22,713	99%	121%	104%
Watson Wyatt proposal compared to prior rates		62%				
M&R proposal compared to revised rates			90%			

Watson Wyatt reduced the effective number of retirement by over one-third to reflect the impact of the 1998 benefit package. We do not believe delays of this magnitude will occur, and recommend reducing the effective number of retirements by about 10%.

The following tables (first males, then females) show the actual, expected, and recommended probabilities of retirement. Rates are still needed to reflect the behavior absent the impact of the 1998 benefits package to track the impact of the legislation.

Males at Age	Probability of Retirement				
		Valuation	WWW	Recommendation	
	Actual	Expected	> 1999	< 1999	> 1999
54	0.0%	2.5%	1.5%	1.5%	1.5%
55	5.0	6.3	4.3	5.8	5.0
56	3.8	5.8	2.8	3.9	3.5
57	5.1	7.2	3.2	4.9	4.0
58	6.7	10.4	5.4	6.8	6.0
59	16.0	22.2	16.2	17.5	15.0
60	22.8	26.1	19.1	25.0	20.0
61	16.2	21.4	14.4	16.5	14.0
62	16.8	21.4	14.4	16.5	14.0
63	15.6	21.4	14.4	15.0	25.0
64	17.4	27.6	14.6	17.5	25.0
65	21.3	28.3	53.3	20.0	20.0
66	17.5	26.1	13.1	16.0	16.0
67	15.9	23.0	10.0	16.0	16.0
68	15.2	25.3	12.3	16.0	16.0
69	17.9	25.3	12.3	16.0	16.0
70	12.1	100.0	100.0	100.0	100.0

Females at Age	Probability of Retirement				
		Valuation	WWW	Recommendation	
	Actual	Expected	> 1999	< 1999	> 1999
54	0.0%	2.5%	1.5%	1.5%	1.5%
55	6.2	6.8	4.8	7.0	6.0
56	4.2	5.8	2.8	4.5	4.0
57	5.0	7.0	3.0	4.5	4.0
58	6.2	8.6	3.6	7.0	6.0
59	12.3	17.4	11.4	14.0	9.0
60	19.9	19.8	12.8	22.0	12.0
61	13.9	17.4	10.4	15.0	13.0
62	14.2	17.4	10.4	15.0	17.0
63	14.3	18.2	11.2	15.0	25.0
64	17.0	23.8	10.8	18.0	25.0
65	18.2	24.6	49.6	18.0	19.0
66	18.0	23.0	10.0	18.0	16.0
67	15.8	22.2	9.2	18.0	16.0
68	15.6	23.0	10.0	16.0	16.0
69	16.1	26.1	13.1	16.0	16.0
70	12.4	100.0	100.0	100.0	100.0

Impact on the Valuation: The impact of this recommendation will be a material decrease in the Normal Cost Rate and Actuarial Obligation due to the expectation that some members will delay their service retirement due to the higher benefit accruals after age 60, and the career bonus formula.

Two sets of retirement rates are needed to assess the cost of the 1998 benefits package.

DISABLEMENT

Due to the enactment of new disability provisions in 1992, we established higher rates of disablement for Coverage B members in the 1993 Actuarial Valuation. A summary of our current findings and recommended changes is shown in the following chart.

	Number of Disablements – 1999 Study			Actual / Expected Ratio		
	Actual Number	Expected Number	Revised Expected	1995 Study	1999 Actual	1999 Revised
Coverage A						
Male	264	272	n/a	95%	97%	n/a
Female	590	558	n/a	102	106	n/a
Total	854	830	n/a	100%	103%	n/a
Coverage B						
Male	234	313	258	95%	75%	91%
Female	703	839	784	93	84	90
Total	937	1,152	1,042	94%	81%	90%

We lowered the rates of disability for Coverage A members in the last study, and the number of Coverage A disabilities in this study was very close to the number assumed. Therefore, we are not recommending any changes in the rates of disability for Coverage A members.

There were fewer Coverage B disabilities in this observation period than we assumed. We expected higher disability rates for Coverage B because of the greater benefits and the added incentive for members to apply for a disability. It is clear that an adjustment is warranted, particularly for the males. The initial anti-selection during the 1992 election process may have disappeared. That is, some members who perceived they were in less than average health, or were contemplating filing for disability, would have been more apt to elect Coverage B thus lowering the overall health of Coverage B members when compared to the Coverage A members.

Because the Coverage B disability benefit is not directly proportional to service, we expected, and have seen, higher rates of disability for members who entered the System at later ages. We have three sets of Coverage B disability rates; one for those who enter prior to age 40 (originally assumed to be the same rates as for Coverage A members), one for those who enter the System between the ages of 40 and 44, and one for those who enter the System at or after age 45.

We are recommending reductions to the rates for those who enter the System at all ages, with the largest reductions occurring at the older entry ages.

Current Assumption:	Coverage A	Special rates by age only
	Coverage B	Special rates by entry age group
Recommendation:	Coverage A	No changes
	Coverage B	Reductions in rates in all groups

Impact on the Valuation: The impact of this recommendation will be a decrease in the Normal Cost Rate and Actuarial Obligation due to the expectation that fewer members will become disabled under Coverage B in the future.

WITHDRAWAL

All Terminations: Actual and expected numbers of terminated members under the current and recommended assumption are shown in the following table. These figures represent all members who terminated active membership, whether or not they elected a refund.

Entry Age	Number of Retirements – 1999 Study: Actual Number	Expected Number	Revised Expected	Actual / Expected Ratio: 1995 Study	1999 Actual	1999 Revised
Male						
under 30	5,950	6,994	6,403	87%	85%	93%
30-34	2,239	2,647	2,382	93	85	94
35-39	1,675	1,950	1,771	95	86	95
40-44	1,463	1,622	1,518	100	90	96
45 & up	2,105	1,826	2,043	100	115	103
Subtotal	13,432	15,039	14,117	94%	89%	95%
Female						
under 30	14,435	19,469	15,967	89%	74%	90%
30-34	3,662	4,681	3,853	92	78	95
35-39	2,867	3,966	3,179	86	72	90
40-44	2,650	3,304	2,774	84	80	96
45 & up	2,685	3,815	2,687	88	70	100
Subtotal	26,299	35,235	28,460	89%	75%	92%
Total	**39,731**	**50,274**	**42,577**	**90%**	**79%**	**93%**

The rates of termination were reduced in the last study, but further reductions are warranted at this time based on the results of this study. The recommended adjustments go part way toward the 1995-99 experience (not fully to a 100% A/E Ratio). If the experience stays at the current levels, further reductions may be needed in the future.

We found more actual terminations in the second, third, and fourth years of membership than were expected by the current assumption, but fewer terminations at other durations.

Duration	Annual Rates of Termination by Entry Age and Duration							
	Current Assumed Rates				Recommended Rates			
	27	32	37	42	27	32	37	42
Male								
1	14.8%	14.8%	14.8%	14.8%	12.5%	12.5%	12.5%	12.5%
2	8.8	8.8	8.8	8.8	9.5	9.2	9.2	9.5
3	6.8	6.8	6.8	6.8	6.8	6.8	6.8	7.2
4	5.8	5.8	5.8	5.8	5.8	5.8	5.8	6.2
5	5.0	5.0	5.0	5.0	4.2	4.2	4.2	4.2
10	2.5	2.5	2.5	2.5	2.0	2.0	2.0	2.4
15	1.3	1.3	1.3		1.1	1.1	1.2	
20	0.8	0.8			0.6	0.6		
25	0.5				0.5			
Female								
1	14.8%	14.8%	14.8%	14.8%	10.0%	10.0%	10.0%	10.0%
2	8.8	8.6	7.7	6.6	8.3	8.3	7.5	6.8
3	7.7	6.8	5.4	5.1	7.3	6.5	5.5	5.3
4	6.8	5.8	4.4	4.3	7.1	5.6	4.5	4.0
5	5.9	5.0	3.8	3.6	5.8	4.2	3.5	3.0
10	2.5	2.2	1.9	1.6	2.0	1.7	1.4	1.6
15	1.2	1.2	1.2		0.9	1.0	0.9	
20	0.9	0.9			0.7	0.9		
25	0.8				0.6			

Impact on the Valuation: The impact of this recommendation will be a material increase in the Normal Cost Rate and Actuarial Obligation due to the expectation of fewer members terminating, and therefore, more members remaining active until retirement.

Probability of Refund: The following table illustrates, for sample ages and durations, the proportion of terminating members who elect to withdraw all funds and forfeit future benefits. Based on the data from this study period, fewer members are electing a refund at termination. This is consistent with the experience we have seen in other systems.

We recommend that this assumption be revised to closely follow the experience during the observation period, as follows.

	Probability of Terminating Member Electing a Refund by Entry Age							
	Current Assumed Rates				Recommended Rates			
	27	32	37	42	27	32	37	42
Male								
Under 5	100%	100%	100%	100%	100%	100%	100%	100%
10	60	50	50	45	40	40	45	40
15	50	45	45		40	35	35	
20	40	40			35	30		
25	30				20			
Female								
Under 5	100%	100%	100%	100%	100%	100%	100%	100%
10	40	40	40	35	25	30	30	25
15	35	35	35		20	30	20	
20	30	25			20	20		
25	20				20			

Impact on the Valuation: The impact of this recommendation will be a slight increase in the Normal Cost Rate and Actuarial Obligation due to the expectation of fewer vested terminating members electing a refund, and therefore, more members remaining eligible for a deferred retirement allowance.

MERIT SALARY INCREASES

The current merit wage scale was not changed in 1995, but adjustments appear to be reasonable at this time. The actual experience has been dramatically lower than the current assumed rates during the early durations, and somewhat higher at the later durations. We also found relatively consistent experience between males and females, so we are recommending a unisex assumption for merit salary increases.

Annual increases in salaries, exclusive of the economic wage growth assumption, are shown at several entry ages and durations.

Annual Increase in Salaries Due to Merit by Entry Age

	Current Assumed Rates								Recommended Unisex Merit Scale			
	Male				Female							
Yr.	27	32	37	42	27	32	37	42	27	32	37	42
1	8.0%	9.5%	9.8%	8.9%	7.2%	7.7%	8.5%	5.4%	5.3%	5.1%	4.9%	4.9%
5	5.5	5.0	4.2	2.9	5.1	4.6	3.6	3.9	4.8	4.5	3.8	3.8
10	3.6	2.6	1.9	2.0	3.1	2.5	2.7	2.6	3.0	2.7	2.3	2.2
15	1.4	1.0	0.8	0.4	1.3	1.0	1.3	1.5	1.5	1.4	1.1	1.1
20	1.1	0.7	0.7	0.4	0.7	0.6	0.9	1.0	1.2	1.1	0.8	0.8
25	0.8	0.6	0.7		0.6	0.5	0.5		1.0	0.9	0.6	
30	0.7	0.6			0.3	0.4			0.7	0.6		
35	0.7				0.4				0.7			

Impact on the Valuation: The fiscal impact of this recommendation will be negligible. Although the slope of the increases has flattened, the overall effect of the recommended merit salary scale on the results of the valuation will be about the same as the current merit salary scale.

SECTION 5

IMPACT OF THE RECOMMENDED REVISIONS TO THE METHODS AND ASSUMPTIONS

If the recommendations for revised assumptions and methods are adopted, there will be an impact on the costs and funding status calculated in the 1999 Actuarial Valuation. The following paragraphs briefly describe the expected impact.

DB PROGRAM

Actuarial Methods

- **Asset Valuation Method:** We are recommending that the Retirement Board review the selection of the Asset Valuation Method. Any increase in the Actuarial Value of Assets resulting from a change in method will reduce the Unfunded Actuarial Obligation (or increase the Actuarial Surplus).

Economic Assumptions

- **Inflation:** A reduction in the assumed price inflation rate from 4.50% to 3.50% per year will have no direct impact on the results of the valuation. However, future predictions of purchasing power erosion will be based on the revised assumption.

- **Wage Growth:** We recommend a decrease in the assumed rate of future wage growth from 5.50% per year to 4.25% per year. Therefore, the projected pension benefits based on final average salaries will be lower than previously assumed, and the discounted value of these lower projected benefits will produce lower Normal Costs and a lower Actuarial Obligation.

  On the other hand, the Unfunded Actuarial Obligation or Actuarial Surplus will be amortized over future payroll, including increases due to wage growth. Therefore, since the assumed future payroll base will be increasing at a rate of 4.25% per year, rather than at the rate of 5.50% per year, the period required to amortize the Unfunded Actuarial Obligation or Actuarial Surplus will increase due to the change in this assumption.

- **Administrative Expenses:** We are recommending that the provision for administrative expenses be retained at 0.25% of payroll, unless the Retirement Board believes a policy

change to fund administrative expenses from investment returns in excess of the assumed rate is appropriate.

Demographic Assumptions

- **Decrements:** We are recommending that almost all of the decrements be revised to reflect changing trends in experience. Although some changes by themselves may have a significant impact, taken together, the net impact should be negligible. The two recommendations that have the greatest impact are the lower withdrawal rates (increasing expected costs), and later retirements (decreasing costs).

- **Merit Salary Scale:** The recommended revisions in the merit salary scale will have a very small impact on the valuation.

CBB PROGRAM

Although we are recommending that a number of assumptions be revised, we are not recommending any changes to the actuarial funding method and the asset valuation method. Due to the nature of the funding method, the changes in the assumptions will have no impact on the results of the actuarial valuation.

Under the funding method in use, as long as the assumed investment return is equal to the assumed long-term interest credited to member accounts, the Actuarial Obligation will be equal to the sum of the members' nominal account balances.